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THE EVOLUTION OF INSECTS, CHILOPODS, DIPLOPODS, CRUSTACEA AND OTHER ARTHROPODS INDICATED BY A STUDY OF THE HEAD CAPSULE.

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The study of the arthropod head offers some of the most interesting and important evidence indicating the paths of development followed in the evolution of the various types of arthropods, but the evidence from this source has not been brought together, and most of the important types of head capsule have not been figured. The present paper, and the one following it, are offered with a view to supplying this needed information; and in these papers especial attention has been paid to the Crustacea, since these furnish the prototypes of many of the modifications met with in the Insecta, Chilopoda, Diplopoda, etc., and the carcinologists have neglected to furnish us with figures of these important forms.

Lower insects exhibit several types of head capsule, one of which, such as that found in the Collembola (Figs. 4 and 5) Dicellura (Figs. 1 and 13) and Protura (Fig. 12), is characterized by the downward-growth of the subgenal fold *sg* of Fig. 13, covering the basal two-thirds of the maxillae *mx* (and the mandibles also) and extending downward to the labium *li*, which usually remains free of this fold. In this type of head capsule, the mouthparts are not so much "sunken" as they are overlapped by the subgenal fold; and the mandibles apparently extended far backward toward the posterior region of the head before they were overgrown and hidden by the subgenal fold. This type of head was doubtless originally somewhat "horizontal" (as in Fig. 13) or slightly "oblique" (as in Fig. 4) and eventually became more "vertical" (as in Fig. 5) as a later modification. This type of head capsule may be referred to as the Proturoid or entognathous type. It should be noted that in the Proturoid type of head among insects, the labrum *l* of Figs. 12, 13, etc., is distinct, well demarked, and comparatively well developed.

The head capsule of certain diplopods, such as the one shown in Fig. 19, may exhibit a tendency for the subgenal region *sg* to extend downward to a slight extent over the backwardly prolonged mandibles *md;* and the chilopod shown in Fig. 17 and the schizotarsian shown in Fig. 26, likewise exhibit a slight tendency for the backward-produced mandibles *md* to be slightly overlapped by a downgrowth of the lateral region of the head-capsule; but the tendency is not carried to the extent exhibited in the Poturoid type of head among the Insecta, nor is the labrum *l* as clearly demarked or as well developed among the chilopods, diplopods, etc., as it is in the Proturoid type of insectan head-capsule.

I had supposed that the head-capsule of a symphylan such as Scutigerella (Fig. 24) would be remarkably like that of the apterygotan Campodea (Fig. 1), but upon closer examination, the resemblance seems to be more superficial than fundamental, in many respects. It is quite true that the epicraneal

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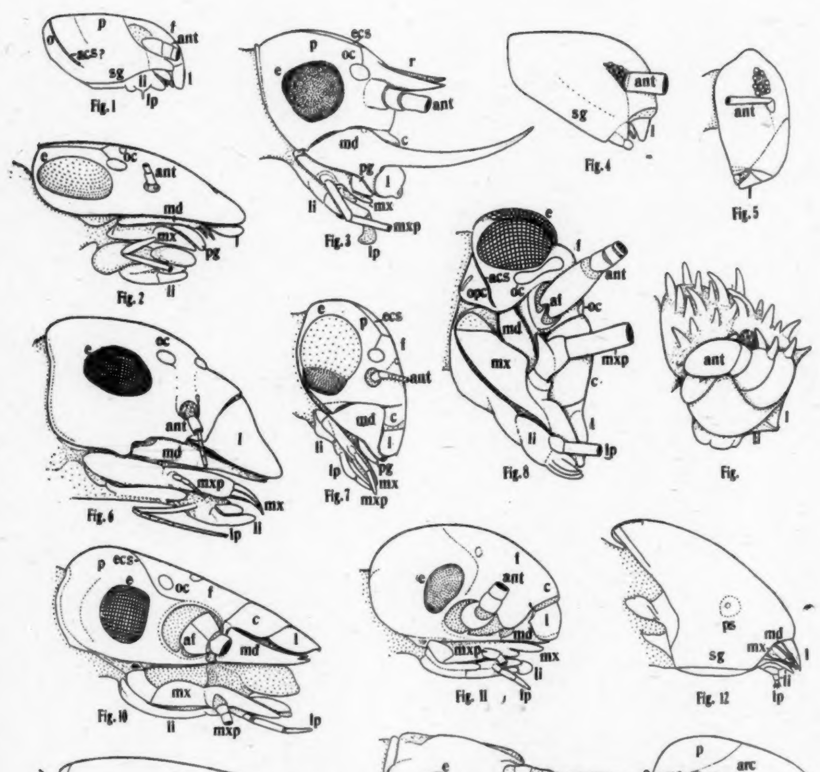

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suture *ecs* of Scutigerella (Fig. 24) is very like that of certain insects (*ecs* of Figs. 3 and 7), but the mandibles *md* and other mouthparts of Scutigerella (Fig. 24) are not overgrown by a lateral fold of the head-capsule, as is the case in Campodea (Fig. 1) and other Dicellura (Fig. 13), and there is no clearly demarked or well developed labrum in Scutigerella (Fig. 24) as is the case in the insects shown in Figs. 1 and 13. In fact, the head capsule of Scutigerella exhibits so many peculiarities such as the peculiar mandibular cleft *acc*, and other features, that it can hardly be considered as very near the insectan type represented by Campodea (Fig. 1), etc. On the other hand, the chilopod shown in Fig. 17 exhibits some tendencies retained in the Proturoid type of head capsules shown in Figs. 1 and 13, etc., in that the chilopod has a slightly developed labrum *l*, it tends to lose the compound eyes, the antennae are shifted forward in the downward-bending of the region of the clypeus and labrum, etc. Furthermore, the schizotarsian head-capsule shown in Fig. 26 is somewhat suggestive of the head capsule of the lepismatid insect shown in Fig. 15, (its antennifer *af*, for example, is an insectan feature) but it is a question whether the abovementioned types of insectan head capsule were inherited from "myriopod" like ancestors, or whether both insectan and "myriopodan" types were inherited from the same crustacean prototypes.

It appears to me that the head capsules of the "myriopods," with their backwardly-prolonged mandibles *md* and downwardly projecting lateral folds—whether these head-capsules be of the Cermatoid type without a distinct labrum (Figs. 16, 22, and 26), or of the Lithobioid type with a fairly distinct labrum *l* (Fig. 17), or of the peculiar Polyxenoid type (Fig. 18), or of the Scolopendrelloid type (Fig. 24)—may all be traced back to a crustacean prototype possibly very like the crustacean type shown in Fig. 35 (or even the crustacean type shown in Fig. 48). Furthermore, the Proturoid type of insectan head capsule, in which the mandibles *md*, which apparently extended far backward, and are overgrown by a downgrowth of the subgenal region *sg* (Figs. 12, 13, etc.), might possibly be traced to a crustacean prototype resembling the type of head capsule exhibited by the crustacean shown in Fig. 35, for example. At any rate, there must have been some tendency in the crustacean stock to have the mandibles prolonged backward, and for the lateral region of the head capsule to grow downward over the mouthparts, or this would not have happened in the crustacean shown in Fig. 35 (and traces of the tendency would not be also exhibited by other Crustacea as well). This tendency, however, did not find expression in most of the descendents of the crustacean stock that retained the purely crustacean features, but it found opportunity for slightly more pronounced "self-expression" among the "myriopod" descendents of the crustacean stock, and found opportunity for very pronounced "self-expression" among some members of the apterygotan insects descended from the crustacean stock.

The tanaidacean, Leptochelia, shown in Fig. 44, has the eyes *e* reduced to a few elements situated far forward near the base of the antennae, and exhibits many features suggestive of the precursor of the lithobiid type of head capsule exemplified by the chilopod shown in Fig. 17, but I am more inclined to consider that the isopod head shown in Fig. 48, which is a modification of the asseloid type of isopodan head shown in Fig. 29, represents more nearly

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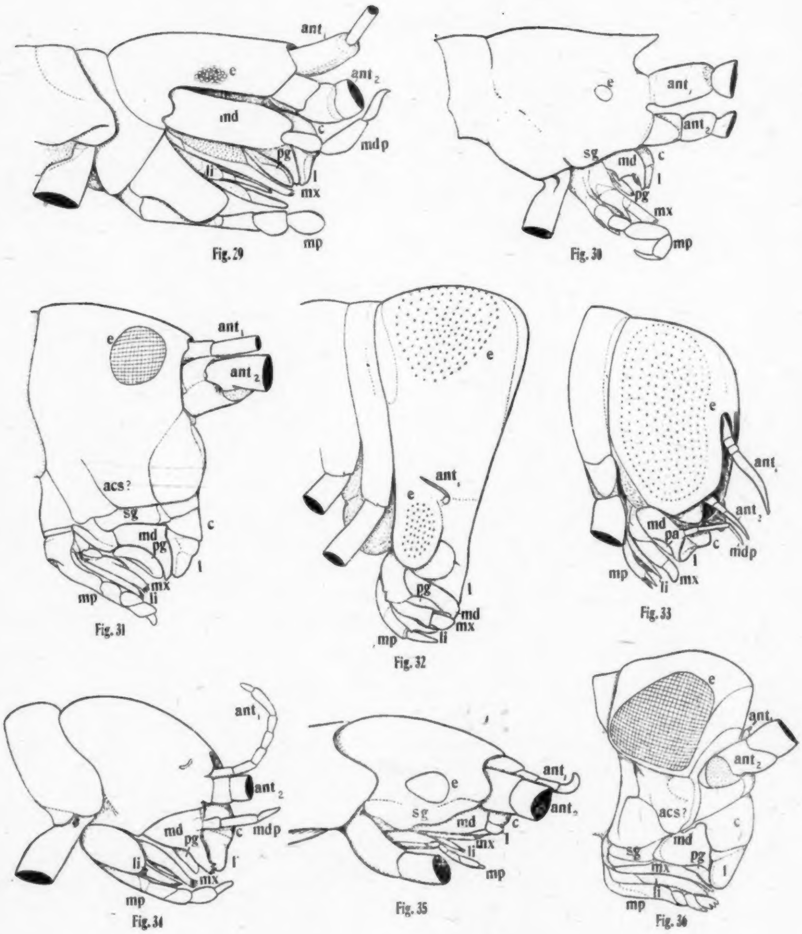
the ancestral type of head from which the typical insectan and "myriopodan" head capsules were derived, although insects and "myriopods" were evidently not descended from the isopod Cassidina (Fig. 48) or Asellus (Fig. 29) either. What I mean to imply is that Asellus and Cassidina have retained, in a slightly modified form, the type of head capsule characteristic of the probable ancestors of "myriopods" and insects, so far as the general character of the skull and the mandibular development is concerned, and the tendencies exhibited by these isopods (Figs. 29 and 48) seem to be the ones that passed over into most "myriopods" and insects, while the isopods in question seem to exhibit these tendencies in a less modified, and hence more ancestral form, than the derived types do.

The isopods shown in Figs. 48 and 29 have two pairs of antennae, as embryology clearly indicates was the case in the ancestors of "myriopods" and insects; the isopods in question have large, backwardly-produced, more or less "horizontal" mandibles with their basal portions extending behind the eyes, as must have occurred in the ancestors of such "myriopods" as those shown in Figs. 26, 22, 16, etc. and in the ancestors of the lepismatoid type shown in Fig. 15; and the nature and location of the eyes of these isopods (Figs. 29 and 48—compare also Figs. 43, and other isopods) indicates a condition ancestral to the insects and "myriopods" in question, as does the location of the antennae and other features. The general shape of the head capsule of the schizotarsian shown in Fig. 26, suggests a close approach to the primitive type of insectan head-capsule exemplified by the lepismatoid shown in Fig. 15, but the labrum is reduced and is not clearly demarked in the myriopods, while the ancestors of the lepismatoid type of insect (Fig. 15) must have exhibited a well developed, clearly demarked labrum (and clypeus also)—and the only place one can find suitable precursors of such structures is in the isopod Crustacea (see Figs. 28, 36, 31, 29, etc.), or their allies.

Although the compound eyes *e* are well developed only in the machiloid types (Fig. 8) among the Apterygota, I think that the lepismatoid type of head (Fig. 15) is the nearest representative of the type from which the pterygotan head capsules were developed, and the nearest approach to the lepismatoid type among the Pterygota (or winged insects) occurs among the naiads, or "larvae" of the ephemerids, which serve to connect the lower pterygotan types with the more modified types occuring in winged insects. Thus, in the head capsule of the immature ephemerid shown in Fig. 6, the important features are rather lepismatoid (compare Fig. 15) in having the maxillae *mx* and labial appendage *li* rather loosely associated with the head capsule, and in having the mandible *md* very large and horizontally directed, although the basal articulatory points of the mandible (in the lateral clypeal and postgenal regions) are nearer together in the ephemerid than they are in the lepismatoid head (Fig. 15). In the immature ephemerid shown in Fig. 3, the labrum *l* and clypeus *c* are bent downward; and although the mandible *md* is hugely developed, its clypeal and postgenal articulatory points become somewhat more closely approximated, and the head becomes more "oblique." In the immature ephemerid shown in Fig. 7, the head assumes a more "vertical" position, and the basal articulatory points of the mandible *md* are much nearer to each other, and the mandible now as-



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sumes more nearly the character of the mandibles of the higher forms, as is true of the head capsule in general. The ephemerids thus offer some rather interesting transitional stages between the lepismatoid and orthopteroid types of head capsule. An extremely flattened type of head capsule apparently derived from the type shown in Fig. 6, is illustrated by the ephemerid shown in Fig. 2, but this peculiar modification has no especial interest for comparison with the higher forms.

The primitive plecopteran naiad ("larva") shown in Fig. 10, illustrates a type of head capsule that might have been derived from an ephemeroid prototype (Fig. 6) through the shortening of the mandible *md* and a forward shifting of its postgenal articulation, which is now quite near the clypeal articulation, as in the typical orthopteroids, but the mandible tends to remain in the primitive horizontal position, and the labrum *l* and clypeus *c* are directed forward in Fig. 10, more like the condition characteristic of the primitive ephemerid head capsule. In the immature Plecopteron shown in Fig. 11, the head arches up more, and the labrum *l* is somewhat more "deflexed." The odonatan head capsule shown in Fig. 14 might also be derived from an ephemeroid prototype, since the maxillae and labium are very loosely associated with the head capsule, and the mandibles (which are shifted far forward, with approximated basal articulatory points) are held in a more or less horizontal position, but the labrum tends to project downward.

I would again emphasize the fact that the primitive ephemeroid type of head shown in Fig. 6 and the lepismatoid type of head shown in Fig. 15 might readily be derived from types like the schizotarsan shown in Fig. 26 or the diplopod shown in Fig. 18, and the proturoid type of head shown in Fig. 4 might also be derived from some prototype like the diplopod shown in Fig. 18, which is an extremely interesting and important form; but, while I would not deny such an origin for insects in general, I am more inclined to consider that the undeniable resemblances between insects and "myriopods" is due to a common heritage from common ancestors in a crustaceoid stem which gave rise to the isopods, "myriopods" and insects.

The rostrum *r* of the ephemerid shown in Fig. 3 may have nothing to do with the rostral projections of various Crustacea (*r* of Figs. 30, 27, 52, 54, etc.), but the paragnaths *pg* of primitive insects (Figs. 3, 2, etc.) are a typical crustacean feature (though they occur in some "myriopods" also); and a well developed and demarked labrum is so typical of insects that one must conclude that the ancestors of insects typically exhibited a well developed and demarked labrum. Since the "myriopods" do not show a marked tendency to preserve the labrum, we must conclude that the Crustacea rather than the "myriopods" exhibit more of the tendencies which must have been shown in the head capsule of the ancestors of the Insecta, than is the case with the "myriopods;" and on the whole, the Crustacea (particularly the types ancestral to the isopods and Tanaidacea) offer more suitable starting points for the derivation of the various insectan structures than the "myriopods" do.

In the Crustacea, the mandibles *md* may be more "vertical" (Fig. 50—or the vertical modifications shown in Figs. 34, 30, etc.), or they may be more "horizontal" (Fig. 29—or the modification shown in Fig. 35), or they may be

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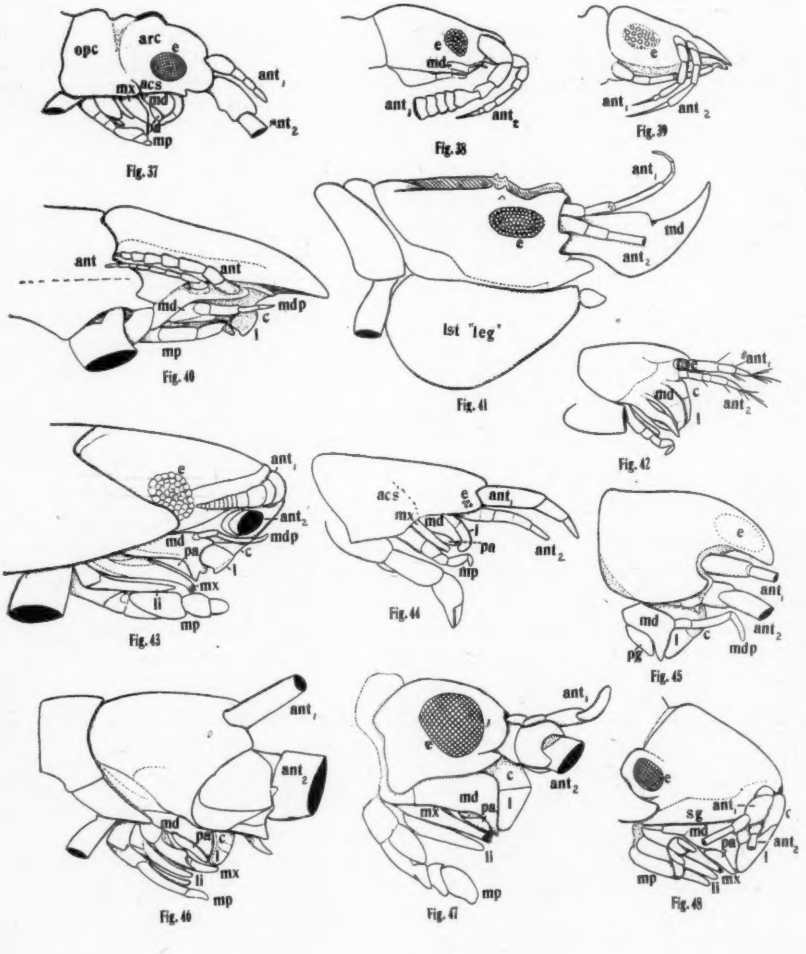

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thrown far forward (as in Figs. 41 and 39), so that all of the modificational tendencies exhibited by the mandibles of lower insects are presaged, so to speak, in the Crustacea, while the "myriopods" as a rule, do not exhibit as many "adumbrations" of the modifications met with in insects (which are apparently later arrivals upon the scene than either the "myriopods" or Crustacea). The *elongated vertical* type of mandible *md* exhibited by the Crustacea shown in Figs. 50 and 52 (or in the Crustacean shown in Fig. 27) seems to be more like the type of mandible found in such primitive forms as Estheria, Apus, Branchippus, etc. (discussed in the next paper), so that the more *"horizontal,"* posteriorly-prolonged aselloid type, (Fig. 29) of mandible *md* may have been derived from the elongated "vertical" type, as is also indicated by the fact that Apseudes (Fig. 50) which exhibits the elongated vertical type is more primitive than its relative Asellus (Fig. 29) which exhibits the elongated horizontal type of mandible. Most "myriopods" (with the exception of the one shown in Fig. 18) and many of the primitive types of insects (Figs. 15, 13, 6, etc.) exhibit a pronounced tendency to retain the elongated "horizontal" type of mandible, and one might be led to infer that this is the primitive or original type for insects (and possibly for "myriopods" also). On the other hand, that peculiar, primitive, crustacean-like insect, Machilis (or Petrobius), which has retained a host of ancestral features suggestive of an origin in crustaceoid forebears, is unique in preserving an elongated vertical type of mandible *md* of Fig. 8, which is undeniably crustacean in outline, articulation etc.; and this type of elongated, vertical mandible is more like the original condition in the ancestral group Crustacea, than the horizontal type is, in this same ancestral group Crustacea. Since the Machiloids are such primitive insects, one might be led to conclude that the elongate vertical type of mandible is the original type for insects also, and that the horizontal, posteriorly-prolonged type found in so many primitive insects was derived from an elongated vertical machiloid type in the group Insecta, instead of being a retention of a posteriorly-prolonged horizontal type already developed in the isopod-like precursors of the insects and "myriopods." I am a firm believer, however, in the view that certain tendencies (adumbrations) existing in (and hence exhibited by) some members of an ancestral group, will be carried over into certain descendents or derivatives of such an ancestral group, and these tendencies will exhibit themselves when the conditions are favorable (possibly through the favorable combinations of "determinants" or "genes" or something of the kind) though they may not be able to do so in all of the members of the derived group. Thus, for example, we may assume that in the physico-chemical make-up of the original crustaceoid stock from which insects were derived, there existed a pronounced tendency to form the mandibles in the primitive vertical fashion (Fig. 50), but there was also present in the ancestral crustaceoid stock the potentiality (otherwise latent) of forming the mandibles in the horizontal position (Fig. 29) if the right conditions favored it. When the primitive insects were derived from such a crustaceoid stock, these tendencies and potentialities were continued in the derived stock. This resulted in the formation of the vertical type of mandible in such primitive insects as the machiloids (Fig. 8) but the potentialities for forming the mandibles in the horizontal position (Fig. 15) likewise persisted from the crustaceoid origin of the insectan

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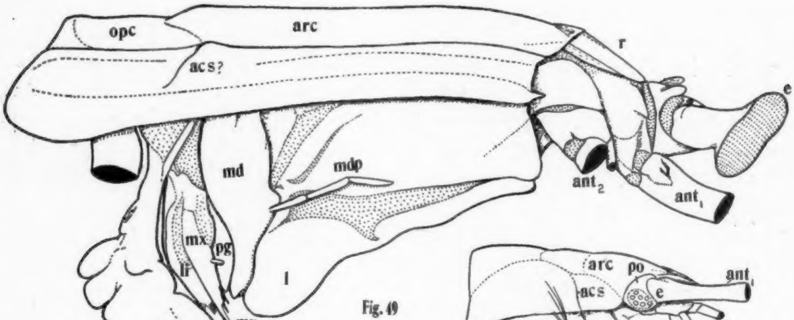

Fig. 49

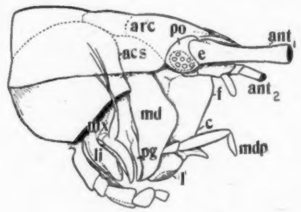

Fig. 50

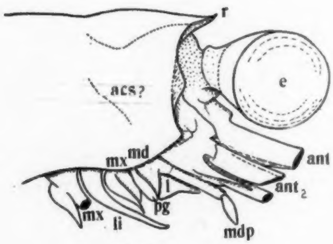

Fig. 51

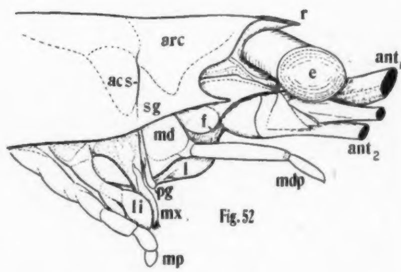

Fig. 52

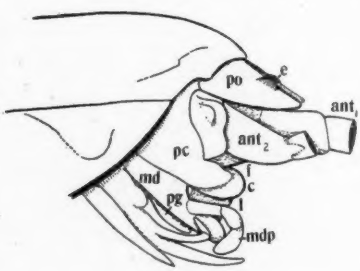

Fig. 53

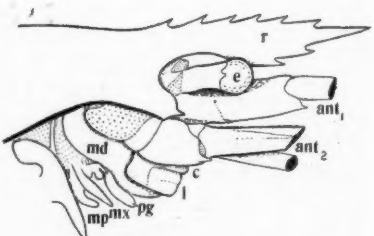

Fig. 54

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stock, and caused the mandibles to form in the horizontal position in insects (Figs. 15, 6, etc.) when the conditions were favorable. This is the only way in which I can explain the fact that we find tendencies exhibited by some members of an ancestral stock, repeated in some members of a derived stock (i.e. the adumbrations exhibited in an ancestral group again find opportunity for expression in a derived group); and while this explanation is not entirely satisfactory, it is at least in accord with a host of observed facts.

The machiloids (Fig. 8) have not only retained the primitive vertical type of mandible *md*, with its crustaceoid type of articulation, etc., but they have also apparently retained the very ancient archicephalic suture *acs* of Fig. 8, which extends upward from the basal end of the mandible *md* in exactly the same way that the archicephalic suture extends upward from the base of the mandible *md* in such Crustacea as those shown in Figs. 27, 52, 50, etc. In the lower Crustacea the archicephalic suture (*acs* of Fig. 27) marks off the primitive head-region apparently containing the mandibular, antennal and antennular segments, so that if the suture labelled *acs* in Fig. 8 is actually homologous with the archicephalic suture *acs* of Fig. 27 (as seems to be the case) the presence of this suture in an insect (Fig. 8, *acs*) is of the greatest importance as a landmark indicating that the region immediately in front of this suture belongs to the mandibular segment, and the region behind it belongs to the maxillary segment, which usually merges into the labial segment. Since there are practically no other landmarks delimiting the segments of the head in the skull of an adult insect, I have attempted to identify the archicephalic suture in other insects; and I would suggest that the suture *acs* extending upward from the basal end of the mandible *md* in the lepismatid shown in Fig. 15, and the suture labelled *acs* extending upward from the general position of the base of the overgrown mandible of the insect shown in Fig. 13, represent the archicephalic sutures. If this be correct, everything in front of these sutures belongs to the mandibular, antennal and antennular segments which thus constitute most of the head capsule, and only the small region behind this suture belongs to the maxillary and labial segments, whose appendages are usually very loosely associated with the head capsule, possibly because they remain rather large and cannot be accommodated in the small area to which their corresponding segments are restricted.*

The primitive head-region, and the archicephalic suture demarking its posterior limits in the lower Crustacea, are described more fully in the second paper of this series, dealing with the lower Crustacea, and other arthropods; but since it may not be clear as to what is meant by the representatives of these structures mentioned above, it may be advisable to describe these parts very briefly. As may be seen by referring to Figs. 55, 60, 65, 57, etc., of the succeeding paper, a suture called the archicephalic suture extends upward from the dorsal end of the more or less vertical mandible in such primitive forms as Estheria (Fig. 55), Apus (Fig. 60), Branchippus (Fig. 65), Centropages (Fig. 57) etc., and serves to demark the posterior limits of the primitive head or archicephalon, which corresponds to the head of the nauplius in which the only head appendages

*—Some embryologists, however, maintain that the mandibular segment belongs with the first and second maxillary segments in the gnathocephalon, and if this be true, the mandibular segment would lie behind the archicephalic suture.

are the antennae, antennules and mandibular limbs. The archicephalic suture is thus a tremendously ancient structure.

In Anaspides (see Fig. 27 of the present paper) the archicephalon *arc* is very distinctly demarked from the opisthocephalon, or "opisthon" *opc*, by a well developed archicephalic suture *acs*, and the group of segments comprising the posterior area *opc* includes but few segments, so that the composite region made up of the areas *opc* and *arc* is very head-like. Such a head-like, composite region is referred to as a syncephalon to distinguish it from a cephalothorax, which is composed of too many segments to appear head-like. Even in such forms as the amphipod Caprella (Fig. 30) in which an extra segment enters into the syncephalon, the fusion product is still sufficiently head-like to be called a syncephalon, and the same is true of such forms as the isopod Arcturus (Fig. 37) which has preserved enough of the archicephalic suture *acs* and the groove above it, to differentiate the primitive head region *arc*—but the syncephalon (*arc* and *opc*) is sufficiently head-like to be called a syncephalon instead of a cephalothorax.

It is necessary to have for reference the figures of the head capsule and its appendages in trilobites, etc., in pointing out that insects and "myriopods" cannot be derived directly from such forebears. On this account, it is preferable to postpone the discussion of this phase of the subject for the second paper, in which the lower Crustacea, trilobites and other arthropods are described, and their origin from annelid-like prototypes is discussed. The bibliography is given at the end of the second paper, to avoid unnecessary duplication.

Abbreviations

A more complete list of abbreviations is given at the end of the second paper, but the following list is sufficient for the purposes of the present paper. *ant*..Antennae in general. ant_1..First antennae (antennules). ant_2..Second antennae (antennae, s. str.). *acc*..Mandibular (archicephalic?) cleft. *acs*..Archicephalic suture *af*..Antennifer. *arc*..Archicephalon. *e*..Eye. *ecs*..Epicraneal suture. *c*..Clypeus. *f*..Frons. *l*..labrum. *li*..second maxillae or labium. *lp*.. Labial palpus. *md*..Mandible. *mdp*..Mandibular palpus. *mp*..Maxilliped, "poison claw," etc. *mx*..Maxillae (first). *mxp* maxillary palpus. *o*..Occiput. *oc*.. Ocelli. *poc*..Opisthocephalon ("opisthon").. *p*..Parietal region. *pa*..Postantennal organ (?). *pg*..Paragnatha. *ps*..Pseudocculus (postantennal organ?). *po*.. Parocculus (occulifer). *sg*..Subgena. *r*..Rostrum, or rostral plate.

Explanation of Plates

All figures lateral views of the arthropod's head, in which the anterior region is directed toward the right hand margin, and the dorsal surface is upward.

Fig. 1. Campodea (Dicellura, Apterygota, Insecta).
Fig. 2 Immature ephemerid-Heptagenia.
Fig. 3. Immature ephemerid-Ephemera.
Fig. 4. Apterygotan collembolan-Tomocerus flavescens.
Fig. 5. Apterygotan collembolan-Papirius.
Fig. 6. Immature ephemerid-Ameletus perscitus.
Fig. 7. Immature ephemerid-Blasturus.
Fig. 8. Apterygotan thysanuroid-Petrobius (Machilidae).
Fig. 9. Apterygotan collembolan-Holacanthella.
Fig. 10. Immature plecopteron-Thaumatoperla.
Fig. 11. Immature plecopteron-Peltoperla.
Fig. 12. Apterygotan proturan-Eosentomon.
Fig. 13. Apterygotan dicelluran-Heterojapyx victoriae (Japygidae).
Fig. 14. Immature odonatan-Gomphus.
Fig. 15. Apterygotan lepismatid-Lepisma.
Fig. 16. Diplopod-Sphaerotherium.

Fig. 17. Chilopod-Scolopendra.
Fig. 18 Diplopod-Polyxenus.
Fig. 19. Diplopod-Siphonotus.
Fig. 20. Crustacean-Glypturus aeanthochirus (decapod).
Fig. 21. Crustacean-Chelura terebrans (amphipod).
Fig. 22. Diplopod-Spirotreptus.
Fig. 23. Crustacean-Bathynella natans (Syncarida, Anaspidacea).
Fig. 24. Symphylan-Scutigerella.
Fig. 25. Crustacean-Koonunga cursor (Syncarida, Anaspidacea).
Fig. 26. Schizotarsian-Cermatia (Scutigera) forceps.
Fig. 27. Crustacean-Anaspides tasmaniae (Syncarida, Anaspidacea).
Fig. 28. Crustacean-Scyphax ornatus (isopod).
Fig. 29. Crustacean-Asellus (isopod).
Fig. 30. Caprella (amphipod crustacean).
Fig. 31. Crustacean-Talorchestia longicornis (amphipod).
Fig. 32. Crustacean-Phronima sedentaria, male (amphipod).
Fig. 34. Crustacean-Phreatoicus kirkii (isopod).
Fig. 35. Isopod-Paridoka.
Fig. 36. Crustacean-Ligia or Ligyda (isopod).
Fig. 37. Crustacean-Arcturus longicornis (isopod).
Fig. 38. Crustacean-Anthura gracilis (isopod).
Fig. 39. Immature crustacean-Gnathia maxillaris (isopod).
Fig. 40. Isopod-Nerocila.
Fig. 41 Crustacean-Gnathia maxillaris, male (isopod).
Fig. 42. Crustacean-Tanais tomentosus (Tanaidacea-isopodoid).
Fig. 43. Crustacean-Conilera cylindracea (isopod).
Fig. 44. Crustacean-Leptochelia algicola (Tanaidacea).
Fig. 45. Crustacean-Monoculodes carinatus (amphipod).
Fig. 46. Crustacean-Corophium (amphipod).
Fig. 47. Crustacean-Idotea robusta (isopod).
Fig. 48. Crustacean-Cassidina depressa (isopod).
Fig. 49. Crustacean-Squilla mantis (Stomatopoda).
Fig. 50. Crustacean-Apseudes talpa (Tanaidacea).
Fig. 51. Crustacean-Euphausia (Euphausiacea).
Fig. 52. Crustacean-Mysis stenolepis (Mysidacea).
Fig. 53. Crustacean-Callianassa affinis (Decapoda).
Fig. 54. Crustacean-Palaemonetes (Decapoda).

NEW SILPHIDAE AND MELYRIDAE IN THE CANADIAN NATIONAL COLLECTION.*

BY W. J. BROWN,
Ottawa, Ont.

Anisotoma canadensis n. sp.

Length 2.5-3.2 mm.; width 1.7-2 mm. Oblong-oval, moderately robust and convex; red or reddish-yellow. Head three-fourths as long as wide; finely, sparsely, and uniformly punctate; vertex with two or three coarse punctures. Antennae concolorous; the second and third segments subequal in length; the club and stem subequal in length.

Pronotum five-eighths as long as wide, widest near middle; feebly emarginate at apex; the sides strongly arcuate; hind angles obtuse, distinct; base truncate at middle, distinctly sinuate on each side near the hind angles. Disk finely and sparsely punctate, a row of coarse punctures on each side near base.

Elytra slightly wider than pronotum, the sides moderately arcuate; disk with eight feebly impressed striae, the eighth abbreviated at base, subhumeral stria rather long; strial punctures only moderately coarse; intervals scarcely convex; sparsely and microscopically punctulate, alternate intervals with a few coarse punctures distantly placed.

Mesosternum oblique in front of the coxae, strongly carinate. Metasternum alutaceus, almost impunctate. Abdomen and femora alutaceous, moderately, fine-

*—Contribution from the Division of Systematic Entomology, Entomological Branch, Dept. of Agric., Ottawa.

ly and closely punctate. Legs elongate.

Male.—Anterior and middle tarsi slightly dilated. Posterior femur stout, strongly widened at middle, the posterior margin strongly arcuate but not angulate or dentate, the outer condyle simple. Posterior tibia elongate, the basal fourth straight, strongly arcuate at middle, gradually enlarged from middle to apex.

Holotype.—♂, Saskatoon, Sask., October 29, 1923, (K. M. King); No. 2782 in the Canadian National Collection, Ottawa.

Allotype.—♀, Aweme, Man., July 22, 1922, (R. M. White).

Paratype.—1, Waldheim, Sask., June 26, 1923, (K. M. King); 4, Aweme, Man., June and August, (N. Criddle).

This species must be associated with *alternata* because of the shortness of the third antennal segment. It differs from *alternata* in the form of the posterior femora and tibia and in the elytral characters.

Anisotoma oklahomensis n. sp.

Length 4 mm.; width 2.7 mm. Oblong-oval; moderately robust and convex; reddish. Head about three-fourths as long as wide; very indistinctly and sparsely punctulate; vertex with two feeble coarse punctures on each side. Antennal club blackish; the stem red, distinctly shorter than club; second and third segments equal in length.

Pronotum three-fifths as long as wide, widest near middle; the apex very feebly emarginate; base very feebly arcuate, not sinuate on each side; hind angles obtuse, distinct. Disk finely and sparsely punctate; a row of coarse punctures near basal margin; a short row of coarse punctures on each side near apical margin.

Elytra slightly wider than the pronotum, the sides moderately arcuate; disk with eight distinct striae, the eighth abbreviated and represented on basal third by a few distant coarse punctures; subhumeral stria rather long, not deeply impressed, nearer the margin than usual: strial punctures coarse; intervals moderately convex, obsoletely punctulate and apparently impunctate; alternate intervals with a few coarse punctures.

Mesosternum oblique in front of the coxae, strongly carinate. Metasternum, abdomen, and middle and hind femora alutaceous, moderately, coarsely and sparsely punctate. Legs elongate.

Male.—Anterior and middle tarsi slightly dilated. Posterior femur moderately stout; with a very obtuse but sharp tooth at middle; the margin oblique from tooth almost to apex, moderately arcuate between tooth and base; outer condyle simple. Posterior tibia elongate; inner margin evenly arcuate from basal third to apex, the outer margin almost straight to near apex where it is feebly arcuate, the tibia therefore most slender near middle and gradually enlarged from middle to apex.

Holotype.—♂, Payne Co., Oklahoma, December 12, 1925, (W. J. Brown); No. 2783 in the Canadian National Collection, Ottawa.

This species is associated with *alternata* and *canadensis* by the shortness of the third antennal segment. It is possible that this is the form referred to *alternata* by Horn (Trans. Am. Ent. Soc. VIII, 286). The femoral tooth of the male and the long subhumeral stria distinguish *oklahomensis*. The present species differs from *canadensis* in the male characters of the hind legs, in the form of the antennae and pronotal base, and in the sculpture of the elytra.

pages 143-144 not issued. See letter, omitted in pagination

Agathidium maulosum n. sp.

Bru.

Length (contracted) 1.9 mm.; width 1.3 mm. Body moderately contractile, when in repose with the clypeus in a vertical plane with the elytral humeri. Color pale rufo-testaceous, marked as follows: head narrowly at base, a circular or slightly transverse pronotal spot extending almost to base and apex, scutellum, elytral suture except in apical third, and two lateral elytral spots, black. The sutural stripe is nearly half as wide as the elytra on the basal fourth; it is suddenly narrowed to half its width, then broadens slightly near middle, and gradually narrows to apical third where it disappears; the larger elytral spot is situated within the emargination of the sutural stripe and is sometimes connected to the later at middle; the smaller spot is external to and near the larger.

Head finely, uniformly, not closely punctate; frontal suture deeply impressed; clypeus more than three times as wide as long, squarely truncate, not prolonged beyond the sides of the front, its anterior margin narrowly membranous. Antennal groove without a limiting ridge on the outer side, partially closed beneath by a very narrow lamelliform margin of the inner limiting ridge; third antennal segment elongate, the seventh and eighth equal.

Pronotum just twice as wide as long, strongly narrowed in front, apex deeply emarginate, sides arcuate, hind angles subrectangular and rather broadly rounded; pronotal disk very finely and sparsely, indistinctly punctate.

Elytra very slightly longer than wide, equal in width to pronotum, widest one-third from base, the sides arcuately converging to apex; disk without trace of striae, finely and sparsely punctate, the punctures very feeble and indistinct on the sides.

Mesosternum vertical in front of the middle coxae, these apparently contiguous but very narrowly separated. Metasternum and abdomen alutaceous, the former finely and very sparsely punctate; abdominal segments closely punctate at middle and on posterior margins.

Male.—Front and middle tarsi 5-segmented; hind tarsi 4-segmented.

Female.—All tarsi 4-segmented.

Holotype.—♀, Victoria, B. C., April 11, 1921, (W. Downes); No. 2784 in the Canadian National Collection, Ottawa.

Allotype.—♂, same data as holotype.

Paratypes.—3, same data as holotype.

This species is not closely allied to any previously described. By Horn's table (Trans. Am. Ent. Soc., VIII, 301), it falls near *estriatum*. Its color is quite characteristic, as no other testaceous species is similarly maculate. The wide clypeus, the deeply impressed frontal suture, the unusual antennal grooves, and the apparently contiguous middle coxae are characters worthy of special note.

Collops olahomensis n. sp.

Bru.

Length 7 mm.; width 3.7 mm. Basal two segments of antennae reddish-yellow, the other segments black; head black, the portion in front of the eyes reddish-yellow; pronotum reddish-yellow with two black spots, these oval, not oblique, each separated from apical and basal margin and from the other by approximately half its width; elytra reddish-yellow, each with a large basal and apical blue spot; the former smaller, attaining the epipleura at the humeral angle and the basal margin throughout, the apical spot separated from the basal by a space

subequal to the width of a pronotal spot, sutural margin throughout and lateral margin except at base equally and narrowly pale, the pale apical margin wider; meso- and metasterna black; abdomen reddish-yellow, the segments each with a large black spot on each side, the apical segment largely or entirely black; legs more or less bicolored. Body moderately shining; clothed as usual with short, pale pubescence and longer, sparse, black hairs.

Head and pronotum sparsely, very finely punctate. Elytra moderately coarsely, densely puncured.

Male.—First antennal segment triangular, about twice as long as wide when viewed from the front; second segment as in *balteatus*. Anterior legs reddish-yellow, the tibiae and tarsi partly black; middle femora banded with black, the tibiae and tarsi black; posterior legs black.

Female.—Legs black, the tips of the femora and the anterior trochanters reddish-yellow.

Holotype.—♂, Payne Co., Oklahoma, September 21, 1923, (W. J. Brown); No. 2785 in the Canadian National Collection, Ottawa.

Allotype.—♀, same locality and collector, November 26, 1923.

This species traces to *validus* in Mr. Fall's table (Jour. N. Y. Ent. Soc. XX, 254) and agrees with that species in having the pronotum bimaculate. These species differ in the color of the legs and elytra and in the form of the pronotal spots. The present species is more closely allied to *balteatus* with which it agrees in elytral coloration and in the form of the second antennal segment of the male. In *oklahomensis*, the first antennal segment of the male is more elongate and the elytral punctures are slightly less coarse than in *balteatus*.

Malachius criddlei n. sp.

Length 2.5 mm.; width 1.2 mm. Moderately robust; black; clypeus, labrum and genae yellow; prothorax yellowish red with a wide black median stripe; antenna and anterior and middle legs brownish yellow; posterior legs blackish; pubescence pale, sparse, short, recumbent, and inconspicuous; elytra with a few short erect hairs near base; surface shining.

Head impunctate, microscopically alutaceous, a longitudinal impression on each side joined by a transverse impression between the eyes, the transverse impression with a small fovea at middle.

Pronotum transversely oval, broadly and transversely impressed near base, impunctate, the sides very finely alutaceous.

Elytra scabrous, slightly wider posteriorly.

Male.—Antennae not strongly serrate. Elytral apex almost squarely truncate when viewed from above, the sutural angle prolonged as a short elevated tubercle; inferior plate almost vertical, its margin entire and not extending to the plane of the elytral disk; the appendix oblique, the apex acute and extending to the plane of the elytral disk, not dentate. First segment of anterior tarsus very short when viewed from above, lobately produced beneath, slightly swollen so that when viewed from the side it is seen to be wider than the other segments.

Holotype.—♂, Aweme, Man., June 3, 1922, (N. Criddle); No. 2786 in the Canadian National Collection, Ottawa.

The small size, color, and peculiar elytral modification distinguish this species. It should be placed near the equally small *pristinus*. In the latter, the color is black with the sutural tips yellow and the surface is dull.

The peculiar first segment of the anterior tarsus of *criddlei* is not observable in other species seen by the author.

Tanaops basalis n. sp.

Length (apex of pronotum to apex of elytra) 2.7 mm.; width 1.4 mm.; moderately elongate. Antennae black, the three basal segments yellow beneath; head and pronotum black, the latter with the basal angles narrowly testaceous; elytra bright yellow, each with a triangular black area which exends across base and terminates acutely two-fifths from base near suture; methathorax black, other ventral thoracic sclerites and abdomen pale brown and yellow; legs black, the trochanters and anterior coxae yellow. Rather strongly shining; pubescence sparse, short, pale, and inconspicuous; the elytra with sparse, black, erect hairs on the sides and near apex.

Head three-fourths as wide behind the eyes as long, two-thirds as wide as pronotum, impunctate.

Pronotum four-fifths as long as wide, the sides parallel, impunctate.

Elytra wider posteriorly, depressed at middle, impunctate.

Male.—Antennae extending slightly past the elytral humeri, not strongly serrate, the outer edges of the distal segments not sinuate. Front trochanters without spine. Fourth and fifth ventral segments each with two large, strong impressions, these separated at middle.

Holotype.—Seton Lake, Lillooet, B. C., June 23, 1926, (J. McDunnough); No. 2787 in the Canadian National Collection, Ottawa.

This species should be listed near *terminalis*. Its color is quite characteristic.

Hoppingiana kingi n. sp.

Length 3.6 mm.; width 1.5 mm. Facies of *Hoppingiana brevilabris* Blais. Elongate, subdepressed, slightly cuneiform. Black, the tarsi and trophi brown; feebly shining. Pubescence moderately short and sparse, evenly distributed; that of head and pronotum a little longer, erect, blackish; that of elytra semi-erect, reddish-brownish.

Head almost as long as wide, finely and sparsely punctate, the surface scabrous throughout but smoother at middle; front flat, a large but very feeble impression on each side. Antennae slender, extending to elytral humeri, feebly but distinctly serrate; segments 7 to 10 inclusive triangular in form, each widest at apex.

Pronotum evenly convex, three-fourths as long as wide, widest at middle; sides viewed from above almost evenly and strongly arcuate, almost evenly arcuate when viewed from the side; base very slightly wider than apex, feebly arcuate. Discal sulcus entire but feeble near apex, strongly arcuate, becoming submarginal at base. Disc at middle scabrous, sparsely, deeply and finely punctate, the punctures becoming closer near base; sides very roughly sculptured, the roughened area extending internally slightly past the discal sulcus.

Elytra about twice as long as wide, widest slightly behind the middle, the sides almost straight anteriorly, broadly arcuate posteriorly. Disk very feebly depressed in the central area, rather strongly declivous near the humeri which

are rounded and slightly tumid; finely, not closely punctate and feebly rugulose transversely.

Metasternum and abdomen more shining than the dorsum; the metasternum very sparsely, finely punctate, very sparsely clothed with decumbent reddish-brown hairs; abdomen rather closely, finely punctate, the pubescence similar but only moderately sparse, the fifth ventral segment simple, subtrancate at apex, subequal in length to the fourth.

Holotype.—Cameron Lake, Alta., August 29, 1926, (K. M. King); No. 2788 in the Canadian National Collection, Ottawa.

Paratypes.—1, same data as holotype; 3, Cranbrook, B. C., June 9, 1926, (A. A. Dennys); 3, Creston, B. C., July 9, 1926, (A. A. Dennys); 1, St. Marys, B. C., July 12, 1926, (A. A. Dennys); 8, Rolla, B. C., July 18, 1927, (P. N. Vroom).

This species agrees perfectly with *brevilabris* in those characters of generic value. It differs principally in the form of the antennae, front, and prothorax. In *brevilabris,* antennal segments 7 to 10 are subglobular in form, and the front is strongly impressed on each side. In *kingi,* these antennal segments are triangular in form, and the frontal impressions are very feeble. When the prothorax is viewed from above, that of *brevilabris* is seen to be subangulate on each side, and the margin is oblique from the angle to base and apex; the lateral pronotal margins of *kingi* are seen to be strongly and almost evenly arcuate. When viewed from the side, the lateral pronotal margin of *kingi* does not suddenly become very strongly arcuate near the apex as in *brevilabris.* In addition, the front is more roughly sculptured, the pronotum is more closely punctured at middle near the base, and the pronotal discal sulcus is more broadly arculate near the base in *kingi* than in the other species. Sexual characters are not apparent in type series. There is some variation in the sculpture of the pronotum, some specimens being more strongly scabrous than others. The resemblance of *kingi* to *Dasytes hudsonicus* Lec. is remarkable.

TWO NEW SIPHONAPTERA FROM COLORADO.

BY M. A. STEWART,
Rice Institute, Houston, Texas.

The author of this paper is indebted to Dr. C. P. Gillette of the Colorado State Agricultural College for the privilege of studying a part of the State College's collection of Siphonaptera, in which were found the two new species described below. Unfortunately the specimens of these two new species are somewhat mutilated but after careful examination it is possible to publish the following descriptions.

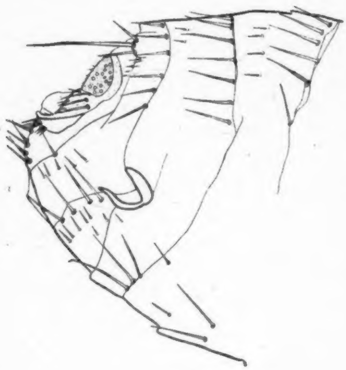
Ceratophyllus peromysci nov. spec.

(Figs. 1 & 2).

Female. Head.—The rostrum reaches nearly to the apex of the fore-coxa and the maxillary palpi are short, not reaching much beyond the maxillae. The head is strongly rounded to the frontal notch, which is distinct. The lower genal row has three bristles, the middle one of which is the shortest, and the upper row has four smaller bristles. The eye is oval in shape. There is one large occipital bristle posterior to the apex of the first antennal segment and two

CAN. ENT. VOL. LX. PLATE 13.

1



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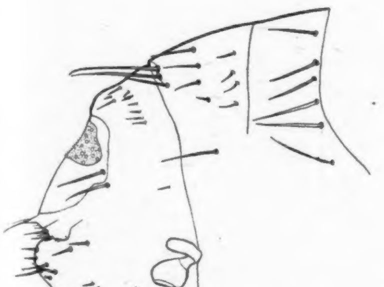

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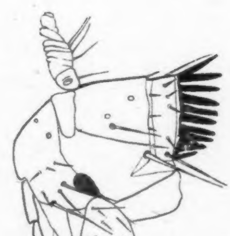


4

Fig. 1. Head of female *C. peromysci.*. Fig. 2. Female *C. peromysci.* Fig. 3. Female *C. citelli.* Fig. 4. Head of male *C. citelli.*

much smaller ones above. The bristles of the second antennal segment could not be seen in the specimens at hand.

Thorax.—There is a row of about eight bristles on the pronotum anterior to the ctenidium. The pronotal ctenidium is composed of about nineteen spines. There are two rows of bristles on both the meso- and metanotum.

Abdomen.—There are two rows of bristles on the second to seventh tergites. On the second abdominal tergite there are two teeth on either side, on the third two teeth, and on the fourth one tooth. The condition of the first abdominal tergite of the specimens studied was such that it was impossible to determine the presence or absence of dorsal teeth The third to sixth abdominal sternites have four apical bristles on each side. There are three antepygidial bristles on each side; the middle one is much longer than the other two.

Legs.—There are about nine relatively long bristles on the inner side of the hind coxa. On the outer side of the hind femur there is a single row of about five bristles, and on the outer side of the hind tibia there are about twelve scattered bristles. The longest apical bristle of the hind tibia reaches to about the apex of the first hind tarsal segment. The longest apical bristle of the first hind tarsal segment reaches nearly to the apex of the second hind tarsal segment. The longest apical bristle of the second hind tarsal segment reaches about three-quarters the length of the third segment. On the fifth tarsal segment of all legs there are five pairs of lateral plantar bristles, the first pair of which is bent inward. The proportions of the hind tarsal segments are as follows: I-1.2, II-1, III-.25, IV-.15, V-1.

Modified Segments.—The seventh sternite is rather heavily bristled. The receptaculum seminis is unique in shape as is shown in Plate I, Fig. 2.

Length. Female.—1.75 mm.

Two females were taken from *Peromyscus* sp. at Cortez, Colorado, May 23, 1926 by S. C. McCambell.

The holotype is deposited in the United States National Museum.

Ceratophyllus citelli nov. spec.

(Figs. 3 & 4).

Male and Female. Head.—The rostrum reaches to about the apex of the trochanter and the maxillary palpi reach to the apex of the fourth segment of the rostrum. The frons is somewhat sharply rounded with a small but distinct notch. The lower genal row is composed of three bristles, the middle one of which is the smallest. The irregular, oblique upper genal row is composed of four bristles. There is one long occipital bristle posterior to the middle of the antennal groove The bristles of the second antennal segment exceed the club in length.

Thorax.—There is a row of about twelve bristles on the pronotum anterior to the pronotal ctenidium, which is composed of about twenty spines. There are two rows of bristles on both the meso- and metanotum.

Abdomen.—There are two rows of bristles on the second to seventh abdominal tergites. There are about eight bristles on each side in the apical rows of the third to seventh abdominal sternites. The number of dorsal teeth on the abdominal tergites is as follows: I—undetermined because of the condition of the specimens, II—2, III—1, IV—1. There are three antepygidial bristles on

each side; in the female the lower one is the shortest; in the male only one is prominent.

Legs.—There are about nine irregularly arranged bristles on the inner anterior side of the hind coxa. On the outer side of the hind femur there is a row of about six bristles. There is an irregular row of about nine lateral bristles on the hind tibia. The longest apical bristle of the hind tibia reaches about three-quarters the length of the first hind tarsal segment. The longest apical bristle of the first hind tarsal segment reaches to the apex of the second hind tarsal segment. The longest apical bristle of the second hind tarsal segment reaches to the apex of the fourth segment. There are five pairs of lateral plantar bristles on the fifth tarsal segments of all legs. The proportions of the hind tarsal segments are as follows: I—1.35, II—1.5, III—4, IV—.2, V—1.5.

Modified Segments.—Female.—As shown in Plate I, Fig. 4. Male.—The male genitalia in the specimens at hand are very badly distorted.

The posterior margin of the movable finger of the claspers is very strongly convex. The upper half of the anterior margin is straight. Below the upper half the anterior margin is strongly concave.

Length. Male.—2 mm.

Length. Female.—2.50 mm.

One male and two females were collected from *Citellus tridecemlineatus pallidus*, Weld County, Colorado, April 20, 1926 by S. C. McCambell.

The holotype is deposited in the United States National Museum.

REVISION OF THE GENUS ODONTAEUS, DEJ. (SCARABAEIDAE, COLEOPTERA).

BY J. B. WALLIS,

Winnipeg, Man.

(Continued from page 128).

Odontaeus falli sp. nov.

Holotype: *Shape and Size*: Broadly oval, elytra somewhat inflated so that the maximum width is in front of middle. Length: 9.59 mm.; width: 6.3 mm.

Color: Black above, piceous brown below, the posterior tibiae and femora darker; antennae brown, the basal joint of club dark. Shining.

Clypeus: Evenly rounded, acutely margined, densely rugose with moderate punctures in the wrinkles, longitudinally tuberculate at middle but not carinate. Horn fixed, rather coarsely punctate at base, finely and moderately closely punctate on front face.

Thorax: Anterior angle slightly less than right, roundly blunt, apex rather deeply sinuate. Sides obliquely divergent from apex for about half length, thence about parallel to basal angles. Basal angles a trifle more than right, rounded, base of thorax only moderately sinuate. Punctate, as usual, coarsely in anterior half—except on medial elevation—and in the depressions, with scattered coarse punctures elsewhere, these sometimes in groups, the whole surface finely and rather evenly punctulate. Medial elevation wide, feebly grooved, the tubercles just behind middle. Lateral foveae round, moderately deep, bounded externally by an acute ridge nearly plane at top but rounding both apically and basally.

Elytra: Striae deep, especially the discal; moderately and rather closely punctured, the punctures mostly separated by less than or about their own diameters. Eleventh stria well developed and punctured much as the others. Fourteenth but little curved away from margin towards base. Intervals more convex than usual in the group, with sparse scattered punctules and a secondary system, visible only under high power, of more plentiful though still sparse very minute punctules. Margin rather wide for group, almost sub-explanate.

Genitalia: Outer lobes pale, darker below. Medial lobe dark brown, linear, regularly curved. (See Fig. 4.).

Allotype: *Shape and Size*: As in holotype but a little less broad. Length 9.52 mm. Width 5.88 mm.

Colour: As in holotype, except that appendages and under side are darker, club of antenna concolorous, dark.

Clypeus: Less evenly rounded, almost sub-truncate in front, otherwise much as in holotype.

Thorax: Outline much as in holotype but narrower. The surface somewhat dulled. Three tubercles, the middle one, transverse, at about apical third, the outer rounded at about apical fourth, in a transverse row; a slight depression behind medial tubercle and a swelling at middle of basal third. Surface coarsely, irregularly and rather densely punctured except on tubercles and on post-medial elevation a fine secondary system of minute punctules visible throughout.

Elytra: As in holotype.

Holotype: Foxwarren, Manitoba. 14.VII.27.

Allotype: Winnipeg, Manitoba. 1. VII.11. Both taken by myself and in my collection.

Specimens examined: 100.

Localities: Saskatchewan, Manitoba, South Dakota, Minnesota, Michigan, Wisconsin, Ontario, Quebec.

As the above indicates *falli* is a widespread northern species with a known range extending from Regina, Saskatchewan, to Quinze Lake, Quebec and south to South Dakota and Wisconsin.

It is a species to be looked for in moderately heavy, dark soil and probably ranges in suitable situations well towards the Rocky Mountains. The few specimens from the U. S. were taken at Volga, S.D., Taylor's Falls, Minn., Marquette and Hrn. Mt. Club, Michigan. The Wisconsin specimen has no other locality. It appears to be rather common near Ottawa, Canada.

Falli is quite closely related to *obesus* Lec. It is, however, smaller, with wider elytral margins and lacks the dense minute elytral sculpture characteristic of *obesus*. These two are our only black species. Immature specimens of each species of varying shades of testaceous may be found. The punctulate elytra of *obesus*, the wide elytral margins of *falli* and the genitalia of each, will readily separate such immature specimens from the normally reddish-brown species.

Odontaeus mobilicornis Fab.

This European species is mentioned merely to complete the survey of the genus.

The colour when mature is black as in the two preceding species, and it further resembles them in the strongly striate elytra with well punctured striae.

The thoracic sides appear normally somewhat sinuate before the hind angles which are therefore more than usually pronounced though bluntly rounded, and the thoracic apex is narrower than in our species.

The horn, however, is movable, more evidently so than in any of our species and the thoracic horns when present are much as in our *thoracicornis* hereinafter described. The genitalia, on the other hand, are more of the *filicornis* type. (See Figs. 6, 7 and 8.)

Odontaeus thoracicornis sp. nov.

Odontaeus cornigerus, Blatchley, nec. Melsh. (Coleoptera of Indiana, p. 938.).

Holotype: *Shape and Size*: Moderately broadly oval. Length: 7.84 mm. Width 5.60 mm. (The head and thorax are much depressed in mounting so that the specimen appears shorter than in its natural position. It is probably really from .75 mm. to 1.00 mm. longer than is given above.)

Colour: Dark brown, the under side, femora and antennae a little lighter. Shining.

Clypeus: Sub-truncate in front, oblique at sides, the front angles broadly rounded, margin poorly defined probably owing to wear, coarsely rugose and punctured, a low medial carina reaching about midway to horn. Horn movable, slightly widening and distinctly flattening apically; finely, evenly and sparsely punctate on front face.

Thorax: Anterior angles slightly less than right, somewhat sharp, apex rather deeply sinuate, sides feebly curved to middle, thence still more feebly curved to hind angles which are nearly right, though bluntly rounded, and prominent; base of thorax quite strongly sinuate; coarsely punctate in the depressions, the usual fine punctules throughout. Medial elevation wide, grooved, open in front, its sides terminating in two tubercles at about middle of thorax. Two subapical shallow depressions separated by a swelling, two larger and deeper post-medial depressions in front of each of which is a stout, reflexed horn pointing obliquely backward towards the scutellum.

Elytra: Striae deep, less so laterally. Strial punctures moderately coarse, deep and close, with a tendency to be closer on the alternate striae. Eleventh stria well developed, strongly and closely punctured. Intervals, especially on disk, convex. Secondary system of fine punctules not observable.

Genitalia: Outer lobes pale brown, medial lobe darker especially basally. Linear, regularly curved as in *obesus* and *falli* but not so long. (See Fig. 5.).

Allotype: *Shape and Size*: Moderately broadly oval. Length: 8.80 mm. Width: 5.60 mm.

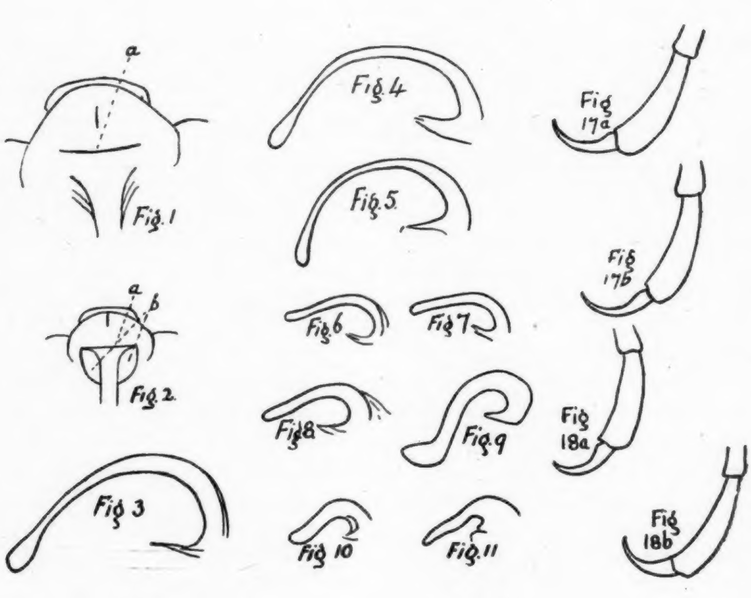
Colour: As in holotype but more nearly concolorous.

Clypeus: As in holotype but a little longer (from front to back) and with the carina a little longer.

Thorax: Outline as in holotype except that there is a faint sinuation at about basal fourth of side. The usual transverse row of three tubercles at a little more than apical third, the middle one transversely longitudinal, the exterior rounded and narrowly separated from the medial.
The whole surface except basally and on the medial elevation coarsely punctured, the usual fine punctules throughout.

Elytra: As in holotype except that the strial punctures are more widely separated and that sparse punctules are visible.

CAN. ENT. VOL. LX. PLATE 14.



THE GENUS ODONTAEUS

Holotype and Allotype: Cincinnati, Ohio, Chas. Dury, who has kindly permitted me to retain them.

These two specimens were determined by Dr. Horn as *cornigerus*, and it appears to be the species recorded as *cornigerus* by Dr. W. S. Blatchley on page 938, "Coleoptera of Indiana," although that author speaks of the horn as being fixed. As already pointed out none of our species has its horn as obviously movable as the European *mobilicornis* Fab., and there is room for a difference of opinion as to just where the line between the fixed and the movable horn species should be drawn. Certainly, however, *thoracicornis* is much nearer the *filicornis* type in this respect than it is to such obviously fixed forms as appear in *cornigerus* as defined in this paper, *obesus* and *falli*.

Specimens examined: 25.

Localities: Pennsylvania, Iowa, Illinois, Indiana (?), Missouri, Kentucky, Tennessee, Ohio, Oklahoma, Kansas, Texas.

The above, if correct, indicates a rather remarkable distribution and it is possible that larger series from different States will permit the describing of other species within this complex. In fact, early in the preparation of this paper I described in manuscript a single male specimen from Baton Rouge, Louisiana, 3.IX.1897., which differs strikingly from typical *thoracicornis*. As more material came to hand, however, it seemed advisable to consider this specimen for the present as an unarmed *thoracicornis*, the male genitalia being practically identical.

Odontaeus floridensis sp. nov.

Holotype: *Shape and Size*: Oblong-oval. Small for the genus. Length: 6.02 mm. Width: 3.64 mm.

Colour: Dark red-brown above, abdomen and antennal club pale yellowish brown, remainder of under surface, and femora a little lighter than upper side, tibiae and tarsi scarcely so. Shining.

Clypeus: Rounded at sides, distinctly emarginate at middle, the strongly elevated margin meeting in the middle at a very obvious angle, giving the clypeus almost the appearance of being bilobed. Surface with large punctures rather more widely spaced than usual in the genus, and with a few scattered small ones, the whole with a feeble tendency to rugosity. Medial carina strongly elevated especially anteriorly where it continues the anterior margin backwards; about two-thirds depth of clypeus. Horn represented only by a swelling very feeble tuberculate each side.

Thorax: Anterior angles acute, feebly blunt, apex rather deeply emarginate and feebly bi-sinuate, the sinuation within the angles moderate. Sides nearly evenly rounding from apex to base, the point of maximum width a little behind middle. Posterior angles obtuse, broadly rounded, the sinuation at base slight. Secondary sexual characters wanting. Transverse ridge well forward nearly at apical fourth, feeble though broad, the usual tubercles rather widely separated, large and very feebly elevated. Medial groove wide and very shallow though suddenly considerably depressed on middle line. Punctures large and moderately sparse, in the usual positions, with an evident secondary system of minute scattered punctules.

Elytra: Striae scarcely impressed except the sutural which is particularly deep, almost grooved, as it approaches the scutellum. Strial punctures large, rather deep and widely separated, usually by at least two, frequently by three or more times their own diameters, a little smaller apically. Intervals scarcely convex. Minute punctules extremely sparse and fine, eleventh stria represented only by a few irregularly spaced punctures, fourteenth stria marginal apically, but leaving margin widely and becoming almost coalescent with thirteenth basally.

Genitalia: Outer lobes pale yellow. Medial lobe pale brownish yellow, a little darker within the "hook," moderately long and linear, almost evenly rounded though feebly sinuate above near tip. (See Fig. 6.).

Allotype: *Shape and Size*: As in Holotype. Length: 6.09 mm. Width : 3.62 mm.

Colour: As in Holotype.

Clypeus: Deeper from front to back than in holotype, the finer punctules and rugosities somewhat more evident, swelling on head a little less with the tubercles a little more evident. The emargination of the front edge and the medial carina even more evident than in the holotype.

Thorax: Almost exactly as in holotype but the transverse ridge and tubercle are a trifle less apical.

Elytra: Very nearly as in holotype, but the sutural striae not quite so deep, the groove continued further apically. Eleventh stria almost completely obsolete.

Holotype: Lake Worth, Fla., Coll. of Mrs. A. T. Slosson (In American Museum of Natural History).

Allotype: Tampa, Fla., Coll. Hubbard and Schwarz (No. 40871 in United States Natural Museum).

The Holotype and Allotype are almost identical, the most important observable difference being in the greater length of the clypeus and the slighter grooving of the sutural stria in the female.

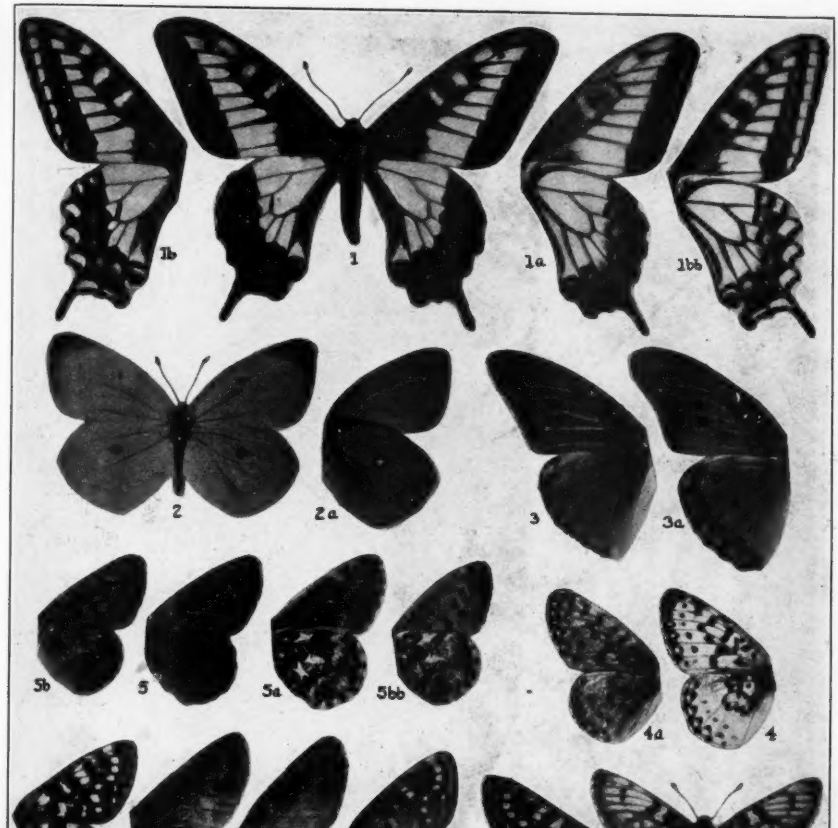
The Holotype was under the name *cornigerus* Melsh. The Allotype is quite probably a specimen recorded as *filicornis* Say from Tampa, Florida, by Dr. Schwarz in his MSS. notes. Dr. Schwarz recorded *filicornis* from Enterprise, and Prof. W. S. Blatchley, (Can. Ent. LII, 263, 1920) from Dunedin. Florida. It may be that these specimens belong here.

I have before me a much larger female, length 7.35 mm., width 4.90 mm., from Kissimmee, Fla., which I tentatively assign here. It has the elytral strial punctures smaller and the thirteenth and fourteenth striae distinct.

Horned specimens are almost certain to occur and if so, judging from the shape of the male genitalia, the horns will probably be movable.

(To be continued)

Mailed Saturday, June 30th, 1928.



NEW TRANSITION FORMS—GUNDER.

PLATE A

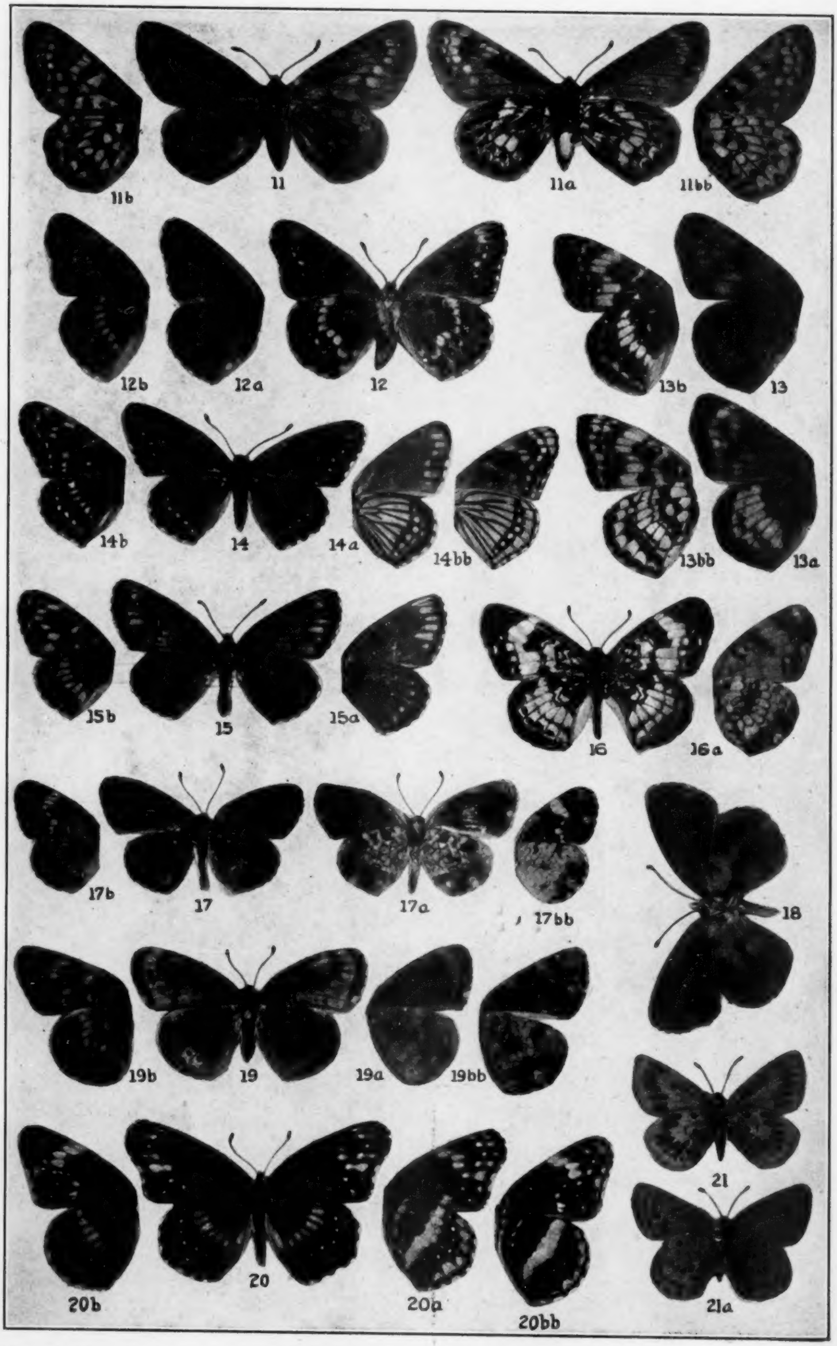


PLATE B NEW TRANSITION FORMS—GUNDER.